

**A Web-based Database for the Mine Burial Program
and
Site Surveys of the Mine Burial/Coastal Processes Experiment Site at the
WHOI Coastal Observatory, Martha's Vineyard**

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LONG-TERM GOALS

The long-term goal of the Mine Burial Program is to develop a better understanding of the coastal processes driving mine burial in shallow water coastal environments.

SCIENTIFIC OBJECTIVES

The overall scientific objectives of the Mine Burial Program are to develop specific models for mine burial driven by coastal processes, to carry out both laboratory and field programs designed to test these models, and to develop probability statements with respect to the likelihood of mine burial. Two field areas have been identified for this project, one off St. Petersburg, Florida and the second off Martha's Vineyard, Mass. The University of New Hampshire is providing support for these objectives through two separate efforts: 1- the development of a web-based database for the Mine Burial Program and; 2- the collection, processing and analysis of high-resolution multibeam sonar data at the Martha's Vineyard field area. In conjunction with investigators from the University of Texas (John Goff), the USGS (Bill Schwab) and Woods Hole Oceanographic Institution (Peter Traykovski) we will use both the sonar data and the database to investigate the statistical properties of sedimentological and morphological variability, as well as track changes in bedform morphology and other time dependent seabed processes.

APPROACH

Site Surveys:

Detailed seafloor mapping and characterization will be critical to the success of both the experimental and theoretical components to the mine burial program. While the sedimentary properties of any survey area must be described before we can understand mine burial processes, we must also understand the variability and areal distribution of sediments in a target location – necessary to understand the natural variability of the burial process. We cannot rely on a few samples in the target area, but rather we need to map and characterize the area as completely, and with as much detail, as possible. Furthermore, we also cannot rely on a single map. We expect the seafloor to change over time – from season to season, and as bedforms migrate along the seafloor (one of the important burial

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mechanisms). We need the capability to map both the morphology and sedimentary properties of the target area as frequently and inexpensively as possible.

We will be using multibeam sonar mapping as our means of monitoring the seafloor and its changes. It is quick and relatively inexpensive and maps can be generated in near real time. The detailed bathymetry provided by the latest technology is unparalleled – in near coastal water depths we will be able to identify and measure mesoscale bedforms on the order of 10 centimeters in height and meters in width. Sidescan backscatter data, however, are not always straightforward to interpret. Sidescan responds to both topographic shading and sedimentary processes – more the latter in the low slopes associated with the sedimentary environment. Hence, we are given the prospect of using sidescan to directly map sedimentary properties. Yet the connection between backscatter and sediment is not usually self-evident. Grain size is obviously important, but not always in ways that one might expect. Density and velocity, ripples, fauna, shell hash and other factors may all play an important part. Rigorous ground truthing of the sidescan data is essential to use such data for broader purposes.

Our intended field program will be multi-staged, beginning with a comprehensive site survey and characterization, and followed by as many as 4 resurveys of key locations for the detection of bedform evolution prior to and during the mine burial experiment. In addition, a separate proposal by the USGS will endeavor to use a 234 kHz interferometric sidescan-sonar and 100 kHz sidescan-sonar system in late Sept. 2001 to inexpensively produce a swath reconnaissance of the area, albeit at lower spatial resolution than will be accomplished by the subsequent surveys survey. This initial site survey will nevertheless be instrumental in planning for future surveys, and for increasing the span of temporal observations.

The mine burial experiment will likely take place in water depths ~10-20 m, and within one or two confined areas ~1-4 km² in extent. These focus areas have not yet been chosen, and we can certainly anticipate that detailed reconnaissance swath map will be instrumental in that choice. For example, one particularly important requirement will be to drop dummy mines in an area of active bedforms, so that the burial of mines by bedform migration can be observed and quantified. Our initial site survey will cover a relatively broad region, to establish the regional geologic character and variability, and for aiding in choosing the optimal site for the mine burial experiment.

Once collected, the swath sidescan data needs to be ground-truthed against the sedimentological and geotechnical properties of the seafloor. As part of the Martha's Vineyard site survey, there will be an effort closely following the swath mapping to collect sediment samples and geotechnical data. We expect to participate in that activity to ensure that the appropriate data types (e.g., grain size distribution, sonic velocity, porosity, density, micro-scale roughness) are collected at the optimal locations for ground truthing the sidescan backscatter data.

In addition to seeking empirical relationships between ground-truth samples and measured backscatter, we will also explore the applicability of backscatter models for predicting backscatter as a function of angle of incidence. The best existing model is that of Jackson et al.(1986). Fonseca (2001) has demonstrated that this model can do a reasonable job of predicting backscatter as a function of angle of incidence if the range of necessary physical and acoustic properties is known and the backscatter data has been fully corrected for instrumental and geometric effects (including local slope). This model is not designed to work at frequencies above 100 kHz and the sonars we will use will be far above that range. As part of our effort we hope to explore the applicability of this model at higher frequencies and, if necessary, see what adjustments must be made to accommodate these frequencies.

We have investigated a number of swath mapping options. Our first choice, use of the Reson 8125 focused multibeam is based on both resolution and availability for event response. The 8125 has demonstrated its ability to achieve higher resolution and faster ping rates than any other multibeam sonar presently available. Positioning also becomes a critical aspect of the type of survey we have in mind and thus we would need to ensure the ability to tie RTK positioning into the multibeam survey. The UNH team has recently had direct experience with the 8125 during surveys of the scuttled German fleet at Scapa Flow conducted in late June. During these surveys the 8125 performed flawlessly, achieving sub-decimeter vertical resolution in water depths on the order of 30 m (Fig 1). With a 0.5 degree beam width and focusing the lateral resolution of this sonar surpasses any commercially available.

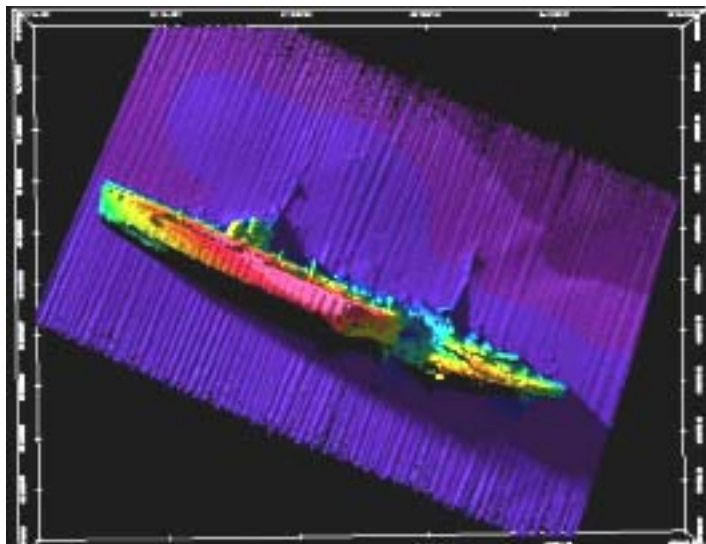


Figure 1. Rendered, color-coded and shaded bathymetry collected over scuttled German cruiser Koln collected with Reson 8125 focused multibeam sonar. Vessel is 200 m long and in 30 m of water.

The straw man schedule for the Martha's Vineyard site survey calls for the USGS reconnaissance in the Summer of 2001, the SAIC Reson 8125 site survey in July of 2002, and a coring/geotechnical program in August of 2002. For the mine burial experiment to be held in 2003-2004, there will be a pre-deployment site survey with the Reson 8125 in the focus areas chosen for the mine burial experiment, and then a post deployment survey to site the mines. Additional sampling may also be conducted. Finally, we anticipate 2 event response surveys with the Reson 8125 during the course of the mine burial experiment. Thus, for the Reson 8125, one larger-scaled site survey and four smaller-scaled follow-up surveys are expected.

Database:

In order to insure the efficient transmission and communication of information between and amongst the investigators involved in the Mine Burial Coastal Processes Program we are establishing and maintaining a web-based database that will serve as a "one-stop shopping" location for background information, planning efforts, data, and results. We will extend this website beyond a mere repository of lists of available data, but rather, take advantage of the inherently geospatial nature of the data to create a web-based Geographic Information System. This will allow investigators to explore the complex inter-

relationships amongst data sets in an intuitive manner. We will do this in a manner that could eventually be extended to support a distributed database so that it may become unnecessary to maintain all data in a single repository.

Specifically, we will implement a database that has inherent web-based analytical capabilities as well as the potential to allow distributed access to the database. The product we will initially explore is Intergraph's GeoMedia which allows access to all of the leading GIS products, so that one can view and analyze multiple data sources simultaneously, all in one environment. A universal GIS client and GeoMedia's live data connections allow organizations to maintain GIS data in native repositories and ensure that the data is always up to date. Data can be integrated automatically using on-the-fly coordinate transformation and feature definition. Each user has the ability, via the web to perform both simple and complex spatial analyses, such as incident and proximity analysis.

WORK COMPLETED

Both of these projects have only just begun. In support of the site survey project we have tested the Reson 8125 and have made arrangements for its future use. In support of the database project we have hired a dedicated GIS specialist, have installed GeoMedia at UNH (with the cooperation of Intergraph) and are beginning to learn its capabilities and deficiencies. We have met with the ONR program and project managers and outlined the form and content of the Buried Mine Project website and database.

RESULTS

None to date.

IMPACT/APPLICATIONS

We hope that the field programs will provide the morphological and sedimentological context for all investigators as well as the potential for the direct measurement of seafloor changes at the test site. The database will become the central repository for all project related work as well as providing the project team and others the tools necessary for efficient data exploration.

TRANSITIONS

None yet.

RELATED PROJECTS

The Buried Mine DRI.

REFERENCES